

LECTURE: 1

ETD 801S: Science, Technology & The Development Process

Instructor:

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TIME: 3:30 – 6:30 PM

VENUE: LT 11

Presentation outline

➤ First session

- Basic definitions/concepts
- Technology evolution (characteristics)
- Invention, innovations and Diffusion
- Technology cluster

➤ Second session

- ❖ Synergy

What is Development?

The questions to ask about a country's development are:

- a. what has been happening to poverty?*
- b. What has been happening to unemployment?*
- c. What has been happening to inequality?*

If all of these have declined from high levels, then beyond doubt this has been a period of development for the country concerned.

M. Todaro, considers development as a multidimensional process involving *changes in structure, attitudes and institutions as well as the acceleration of economic growth and eradication of absolute poverty.*

What is Development? Cont'

A. Sen(1993) considers the process of economic development as the process of expanding the capabilities of people.

Economic development therefore involves:

- Increase in per capita income;
- Changes in the techniques of production which lead to efficiency and increased output per head;
- Changes in the composition of output;
- Changes in patterns of demand
- Changes in the distribution of income;
- Changes in values, attitudes and institutions

NB: Economic dev't = economic growth + change

What are the objectives of Development?

Goulet (1971) distinguishes three basic complement/ core values of development:

- To increase the availability and widen the distribution of *basic-life sustaining* goods such as food, shelter, health and protection;
- To raise the levels of living— for example higher incomes, provision of more jobs, better education to enhance material well being and generate greater *individual and national self-esteem*;
- To expand the range of economic and social choice to individual and nations by *freeing them from servitude and dependence* not only in relation to other peoples and nation-states but also to the process of ignorance and human misery.

What is science?

■ **Science:** refers to the pursuit of *objective knowledge* gleaned from *observation*. Thus, the term refers to a *method* (systematically acquiring and evaluating information) and a *goal* (identifying the nature or governing principles of what is being studied) rather than to any particular phenomenon (**Neale and Liebert, 1980**).

■ The foundation of the scientific approach refers to any activity that systematically attempts to gather evidence through observations and procedures that can be separated and verified by others.

Definition and orientation of technology

Technology simply refers to the *method* for transforming inputs into products and *procedural* and *organizational arrangement* for carrying out the transformation.

The three basic elements are:

- 1) information about the method;
- 2) means of using the method to undertake the transformation and;
- 3) understanding how and why the method works.

Technology is materialized in designs, specifications, formulations, operating instructions, machinery, equipment, buildings, systems, and other tangible or near-tangible forms. These latter should be regarded as the embodiment of technology rather than technology itself.

Definition and orientation of technology cont'

Distinction between:

- Production technology relates to the techniques of production, the meaning with which the term technology is most frequently used.
- Consumption technology relates to the choice of products or systems for the satisfaction of specific consumption requirements.
- Organizational technology relates to the organization of production, distribution and consumption. Its principal determinant is the nature of power relations in the society.

Definition and orientation of technology cont'

Disaggregates a firm's technology into your interlocking-disembodiment into forms;

- **Object – embodied form (“technoware”)** which includes tools, intermediate goods, products, physical equipment, machinery etc.
- **People – embodied form – “humanware”** which refers to understanding, capacity for systematic application of knowledge, know how, specialized ideas, problem-solving capacity etc.

Definition and orientation of technology cont'

Disaggregates a firm's technology into your interlocking-disembodiment into forms;

- **Document-embodied form** – “infoware” dealing with knowledge about physical relationship, scientific/or other form of organized knowledge, principles of physical and social phenomenon, technical information, specifications, standards, computer software etc.
- **Institution-embodied form** – “orgaware” includes organization of work assignment, day-to-day operations of production, social arrangement, organization of product, tools and devices for use by people, inter-and-intra firm networking, linkages etc.

Definition and orientation of technology cont'

It is self-evident that technology is inseparable from the processes of economic growth and development and of capital accumulation (Increased productivity involves the use of improved technologies).

This in turn requires advances in basic research and applied research, development and investment.

But until recently the study of technology was hardly recognized in its own right as a branch of the development sciences. This was probably because capital investment and the application of new technology were seen as closely linked and virtually synonymous.

Classification of technology

- **New technology:** A new technology is any newly introduced or implemented technology that has an explicit impact on the way a company produces products or provide service. (*The technology does have to be new to the world, only new to the company*).
- **Emerging Technology:** An emerging technology is any technology that is not yet fully commercialized but will become so. It may be currently in limited use but it is expected to evolve significantly, e.g. genetic engineering.
- **High Technology:** The term “high tech. (Hi-Tech) refers to advance or sophisticated technologies. A company is classified as Hi-tech if it uses an advance methods in its operations.

Classification of technology cont'

- **Low Technology:** the term “low tech” refers to technologies that have permeated large segments of human society. Low technology are utilized by a wide variety of industries having low or less modern approaches in their operations.
- **Medium Technology:** Medium technology comprises a wide set of technologies that fall between high and low technologies. It usually refers to mature technologies that are more amenable than others to technology transfer. Examples of industries in this category are consumer products and automotive (automobile).

Classification of technology cont'

- **Appropriate Technology:** The term “Appropriate Technology” is used to indicate a good match between the technology utilized and the resources required for its optimal use. The technology could be of any level-low, medium or high. Using the appropriate level of technology results in better use of labour resources and better production efficiency.
- **Codified Vrs Tacit Technology:** technology can be preserved and effectively transferred among users if it's expressed in a coded form. An engineering drawing is a coded form. **Tacit knowledge** is non articulated knowledge. It is usually based on experiences and therefore remains within the minds of its developers. The tech. developers are the ones who have the know-how in question. Tacit knowledge is transmitted through apprenticeship programmes.

Technology Evolution (characteristics)

- All the numerous technology studies of the 20th century share one conclusion: it is simply wrong to conceptualized technical evolution according to a simple linear model, no matter how appealing the simplification. Technical evolution is neither simple nor linear.
- Following **Grübler (1998)**, its form most important distinctive characteristics instead that it is **uncertain, dynamic, systemic and cumulative**.

Technology Evolution (characteristics) cont'

- **Uncertainty** is a basic fact of life, and technology is not exception. The first source of technological uncertainty derives from the fortunate fact that, there always exists a variety of solutions to perform a particular task. It is always uncertain which solution might be “best”, taking into account **technical criteria, economic criteria and social criteria**. Uncertainty prevails at all stages of technological evolution; *from initial design choices through success or failure in the market place, to eventual environmental impact and spin-off effects*. The technical and management literature labels such uncertainty “**a snake pit**” problem.
- It is like trying to put a particular snake out of a pit of hundreds that all looks alike. Others use the biblical quote “**many are called, but few are chosen**”.

Technology Evolution (characteristics) cont'

■ **Technology is dynamic:** it keeps changing all the time. Change includes a continuous introduction of new varieties or “species” and continuous subsequent improvement and modifications. *The varying pace of these combined changes is a constant source of excitement (an over optimism) on the one hand, and frustration (or pessimism) on the other.* As a rule, material component of technology changes much faster and more easily than either its non-material component or society at large. The main factors governing technology dynamics are: first, the **continuous replacement of capital** stock as it ages and economies expand and second, the most important, **new inventions**.

Technology Evolution (characteristics) cont'

■ Technology **evolution is systematic**: it cannot be treated as a discrete, isolated event that concerns only one artifact. A new technology needs not only to be invented and designed, but it needs to be produced. This requires a whole host of other technologies. And it requires infrastructures. A telephone needs a telephone network; a crane needs both a road network and a gasoline distribution system and each of these consist of whole bundles of individual technologies. *This interdependence of technology causes enormous difficulties in implementing large-scale changes.* But it's also what causes technical changes to have such pervasive and extensive impacts **once** they are implemented.

Technology Evolution (characteristics) cont

- **Technology Change is Cumulative:** changes built on previous experiences and knowledge. Only in rare cases is knowledge lost and not reproducible. A new artifact like a new species is seldom designed from “scratch”. *The beginnings of the space programme are notable exceptions, hence, technical knowledge and the stock of technology in use grow continuously.*

Phases in Technology Development

- Schumpeter distinguished three important phases in technology development; **invention, innovation and diffusion.**
- **Invention:** This is “with a concept or the creation of a novel technology. It could be a product, a process, or a previously unknown system”. A new composite material, a newly manufactured product and a new process, constitute inventions. The word “**new**” here implies new to the world. Inventions occur as a result of human ingenuity and imagination. They occur only sporadically, sometimes happening by chance or through trial and error to satisfy a need. Eventhough many inventions are generated by creative people and many of them are patented, only few reach the market place.

Phases in Technology Development cont'

- **Innovation:** This is defined as the point when “a newly discovered material or a newly developed technique is being put into **regular production** for the first time, or when an organized market for the new product is first created”. Innovation involves “the creation of a product, service or process that is new to an organization”. It is the introduction into the market place, either by utilization or by commercialization of a new product, service or process. It does not have to be new to the world; rather, it is viewed as the first use of an idea within an organization, whether or not the idea has been adopted by other organizations ahead.
- Inventions and innovations are intimately related; however, they are not the same. An invention can be thought of as an **invent**, while innovation can be thought of as **process**.

Types of Innovation

- A distinction is frequently made between **process and product innovation**. The former refers to new methods of production, e.g. The Bessemer process of raw steel production. The latter refers to directly useable technical hardware, e.g. consumer products such as video recorders and CD-players.
- Innovations can be classified either on **radial or revolutionary; or as incremental or evolutionary; innovations**. Radical breakthrough innovations are usually based on an invention. They change or create new industries. They are relatively rare and typically start outside the boundaries of a firm. When they are developed within the boundaries of a firm, they signify the introduction of something that is not only new to the organization but drastically different from its existing practices.

[Types of Innovation cont']

- The other category of innovation comprises the **incremental or evolutionary** innovation. These are small but important in a product, process or service. They are relatively common and are created within the firms of an industry. They help companies maintain a competitive position in the market place. **Japan's Kaizen philosophy**; a process of continuous improvement is applicable to this type of innovation, which can bring a significant improvement in the operations of existing enterprises.
- Routine innovation is another term sometimes used to refer to the introduction of something that is new to an organization but very similar to what it had in the past.

What is Diffusion?

- **Diffusion** is the process by which an innovation is communicated overtime, through certain channels to members of a social system (Rgers, 1995).
- The term “innovation” is frequently used in the diffusion literature as been synamous with “technology”.
- Adoption of a certain type of technology in solving a perceived problem. Information about an innovation reaches a potential adopter through communication channels.
- There are many channels for communicating new ideas to potential users, including **inter-personal channels and mass media**.

The rate of adoption of an innovation

- The rate of adoption of an innovation by a social system is dependant on the following factors;
- **The degree** to which the innovation is perceived to be offering **better advantage** than does existing practice; an example is an innovation that offers a less expensive method of producing a product.
- The degree to which the innovation is **compatible** with the **values and needs of users**: e.g. of an incompatible innovation is a new product that may produce pollution in an environmentally sensitive community.
- The degree to which the innovation is considered **complex and difficult to use**: eg. A new process that requires a great deal of effort in re-training employees and has a high cost of implementation.

The rate of adoption of an innovation cont'

- The degree to which the innovation can be **introduced on a trial bases** fore users must fully commit to its adoption: e.g. a new drug that physicians can use on a limited trial bases before prescribing it to all patients. Free samples of drugs given to physician's permits them to do so.
- The degree to which the innovation is seen and its **results** are observed by **potential users**: e.g. a small satellite dish for T.V. viewing. As people see it in use and observe their neighbours satisfaction, with its performance, they are more likely to be willing to use it.
- NB: **Innovations that are perceived** by individual as having greater **relative advantage, compatibility and less complexity and that can be tried and observed** will be adopted more rapidly than other innovations (**Rogers, 1995**)

Technology Clusters

- **Technology cluster** is a bet of interrelated technological and organizational innovations whose pervasive adoption drives a particular period of economic growth; productivity increases, industrialization trade, and associated structural changes.
- At any given time economic growth is driven primarily by the dominant technology cluster, which is frequently associated with the most visible technological infrastructural system of the time.
- But is impossible for a single leading sector, or a few individual industrial or infrastructural innovations to account fully for growth, important as they might be.

Technology Clusters

- Only the combination of many innovations in many sectors and technical fields into entire technical fields into entire technical families/clusters can adequately account for overall economic growth and the expansion of human activities.
- Thus, we emphasize the concept of technology clusters because any dominant individual technology or infrastructure studies under the leading sector hypothesis can explain only a fraction of economic growth.

SYNERGY TIME

- Any problem should be brought forward for discussion.
- Suggestions are welcome
- Wise saying & inspirational words

LETS ENJOY OUR STAY